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In the name of

WILHELM KARMANN GMBH

I, Simon F. Wiles, MITI, MIL, of Sandy Lane, East Grinstead, W. Sussex RH19 3 LP, hereby certify that I am the translator of the attached document, and that it is a true translation, to the best of my knowledge and belief, of the above-mentioned Patent Application.

Signed this: 1st day of July 2003

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Simon S. Wiles, M.A., M.I.L., M.I.T.I.

The invention relates to a folding top for a convertible vehicle in a design according to the preamble to claim 1 as disclosed in US 5816644.

The invention is concerned with the problem of providing a convertible vehicle with a folding top of the type further known from DE 295 13 595.6, the top kinematics of which allow for reduced inconvenience for the occupants of the vehicle thanks to the lesser technical effort in the opening and closing movement of the top, and thereby exhibits overall improved operational convenience.

The invention resolves this problem by a folding top with the features of claim 1. Reference is made to claims 2 to 16 with regard to major further embodiments.

The folding top according to the invention exhibits in the rear area of its two peripheral folding bar modules in each case a two-part bar group as a connection unit to the roof skin, said group consisting of an inherently-known main column and a spreader strut connected to this by a joint on the outside. This spreader strut is connected on the longitudinal edge side to an area of the roof skin in such a way that a connection independent of the main column is formed, and the rear area of the roof skin can also be tensioned and relaxed independently of the movement of the main column. The rear window integrated into the roof skin in the rear area can be relocated by means of this top kinematics arrangement over an extended adjustment range in such a way that the support components move into an upright position and in this situation a trajectory is passed through above the rear area of the passenger compartment of the vehicle which maintains effective head clearance.

During the opening and closing movement of the top, the spreader strut interacts with a tensioning bar for the material of the top, engaging the rear peripheral area of the roof skin, in such a way that a movement of the folding top is achieved which is largely free of tension and eases stress on the material. During the opening of the folding top, the top-tensioning bar and the spreader strut are pivoted upwards against the direction of travel, whereby the roof skin rear area, held by the two components, is raised with the integrated rear window, and, due to the movement of the spreader strut against the direction of travel, the front peripheral area of the rear window also adopts the upright position.

During this opening movement of the folding top, a passenger sitting in the rear of the passenger compartment of the vehicle remains unaffected by the movement of the rear window, because its front peripheral area can be guided on a movement trajectory which extends from the upper area of the interior as far as behind the head rests. In this manner a movement of top parts into the field of vision of the passengers, hitherto found disadvantageous, is avoided, while at the same time any risk to tall passengers in the rear of the passenger compartment is excluded during the movement of the top, and operational convenience is improved overall with this top kinematics arrangement.

Further details and advantageous effects of the invention can be derived from the following description and the drawings, in which an embodiment of the invention is shown in greater detail. The drawings show:

Fig. 1 A side view of the folding top in a closed position, represented without the roof skin,

Fig. 2 a side view similar to Fig. 1 in a first opening phase, during the movement of a tensioning bar for the material of the top and of a spreader strut,

Fig. 3 a second opening phase during the movement of the folding bar towards a top box element located on the rear side,

Fig. 4 a side view with the folding top located in the top box element,

Fig. 5 a perspective sectional representation of the folding bar in the area of the main column, in the closed position,

Fig. 6 a perspective representation similar to Fig. 5 during the opening phase according to Fig. 2, with the top material tensioning bar pivoted upwards, and

Fig. 7 a representation of the principle of a second embodiment of the spreader strut with the tensioning bar for the material of the top connected directly to it by a joint.

Fig. 1 shows a partially sectional side view of a folding top designated overall by 1 for a convertible vehicle, not represented in any greater detail, the roof skin 2 of which extends between bar limbs 4, located symmetrically opposite one another on both sides of the centre plane 3 of the vehicle (Fig. 5), of a folding-bar module 5 which can in each case be fixed in the closed position in the area of the windscreen frame (not shown). The roof skin 3 is provided in the rear side area of the folding top 1, between a top-tensioning bar 6 and a rear corner cross-member 7, with a rear window 8 which for preference consists of solid glass.

The two folding-bar modules 5 (of which only one is represented in the drawings and described hereinafter) exhibit, in a known top kinematics arrangement, facing towards the rear area of the vehicle, in each case a main column 11, connected to a drive element 9 and supported on the bodywork side in a main pivot bearing 10, in the vicinity of which an inner guide bar 12 is provided which is capable of pivoting in synchrony with the main column 11 towards the longitudinal centre plane 3 of the vehicle (Fig. 5).

The top kinematics arrangement designed according to the invention exhibits a main column 11, which is provided with a spreader strut 13 connected to it on the outside, with which the roof skin 2 engages at least in some areas on the longitudinal edge side (not shown). The side view according to Fig. 1 shows that the spreader strut 13, in the closed position of the folding top 1, on the outside in front of the main column 11, adopts a cover position with a direction essentially parallel to the main column 11.

The composition of Fig. 1 and Fig. 2 illustrate the course of movement in a first phase during the opening movement of the folding bar 5, whereby the spreader strut 12 is pivoted in this movement phase independently of the main column 11, and is displaced against the direction of travel into the spread position shown (Fig. 2). As the opening movement of the folding top 1 continues (Fig. 3, Fig. 4), the spreader strut 13 is guided back out of its spread position into the parallel cover position on the outside in front of the main column 11 (Fig. 3), and thereafter the spreader strut 13 and the main column 11 are folded into the top box element 14 of the vehicle, with a simultaneous pivot movement, with the parts of the folding bar 5 (Fig. 4).

In the movement phase according to Fig. 2, the spreader strut 13 is held in its spread position by means of connection elements directed in each case towards the main column 11, which are

represented in greater detail according to Fig. 6 in a perspective rear view, as a possibility for the incorporation of the spreader strut 13 into the top kinematics arrangement. In this situation it becomes clear that a joint connection provided with a front joint lever 15 and a rear joint lever 16 is provided between the main column 11 and the spreader strut 13, said joint connection forming overall a four-member chain A, B, C, D in the manner of a parallelogram control unit.

The embodiment of the folding-bar module 5 described heretofore, with the main column 11 and the spreader strut 13 as a connection unit to the roof skin 2, allows for its vertical displacement section by section, in such a way that the rear window 8 and the rear area of the roof skin 2 which comprises this can be moved on an elevated trajectory R above a passenger P. This movement phase is shown in Fig. 2. The representation, shown essentially to scale, illustrates the possible pivot positions of the rear window 8 during the opening process, with the trajectory R (broken line) and the movement arrow R', while by means of the kinematics arrangement according to the invention with the spreader strut 13, the front window edge 17 of the rear window 8 is no longer displaced forwards into the field of vision of the passenger P, who can remain in the vehicle unaffected by the movement of the top 1 even during the entire opening and closing cycle (Fig. 1 to Fig. 4).

For a force-controlled movement of the spreader strut 13 by means of the top kinematics arrangement, the spreader strut 13 is integrated into the folding bar 5 in the area of the joint components 15, 16, in such a way that an adjustment movement of the folding top 1 created in the area of the main drive elements 9 can be transferred onto the spreader strut 13 by connection parts, the design of which can be selected, such as one of the rod limbs 4, one of the corner cross-members 7, and/or the rear-side top-tensioning bar 6.

In a preferred embodiment, a forced control of the spreader strut 13 is provided by means of the top-tensioning bar 6 which engages with this. It is likewise conceivable that the spreader strut 13 can be provided for the displacement of the roof skin 2 into the relaxation position described heretofore (Fig. 2) by a separate drive element (not shown).

Fig. 7 shows a representation of the principle of an embodiment of simple design of the top kinematics arrangement, with the spreader strut 13 and the top-tensioning bar 6. The top-tensioning bar 6 engages with a pivot-raising module designated overall by S in a pivot joint G, which can be displaced together with the top-tensioning bar 6 into a raised position exhibiting a vertical distance interval H to the main pivot bearing 10 (or to the bodywork balustrade respectively, not shown). The top-tensioning bar 6 is pivoted upwards (arrow K) against the direction of travel during the upwards displacement (distance interval H), whereby the top-tensioning bar 6 interacts in the area of the pivot-raising module S with a raising element formed from a hydraulic cylinder 18.

The pivot joint G in this situation is provided as an end-side connection between the top-tensioning bar 6 and the spreader strut 13, so that in the first opening phase of the folding top 1 displacement takes place under forced control, with pivoting about the joint A', represented as a fixed point of rotation (represented in Fig. 6 as a moving limb 15 with joint points A and B), into a spread position in relation to the main column 11, defining an angle W. By means of an appropriate dimensioning of the distance interval H, achieved by a vehicle-specific dimensioning of the parts of the pivot-lifting module S, these differing requirements can be met for the movement trajectory of the rear window 8 and/or the required head clearance above the passenger compartment.

In the detailed embodiment represented of the folding top 1 with the spreader strut 13 according to Figs. 1 to 6, the strut is connected on its rear end by means of a multi-member chain E to the top-tensioning bar 6 entailing the rear area of the roof skin 2 (Fig. 5, Fig. 6). The top-tensioning bar 6 in this situation exhibits an angled support limb 20 which in the closed position points upwards (Fig. 1), which in the direction of the main bearing 10, with a vibration strut 21, forms in each case joint points L, L' in the area of the main column 11, and is connected on the bodywork side by means of a support strut 21' (Fig. 6).

Accordingly, the top-tensioning bar 6 exhibits at the joint point L a point of rotation located at a distance interval H above the bodywork balustrade, with which a height displacement corresponding to the distance interval H according to Fig. 7 is maintained during the opening movement, whereby, for the displacement of the top-tensioning bar 6 into the upwards pivoted position, its joint point L is arranged in its height position in the bodywork in such a way that a support area located above the bodywork balustrade is attained, and with this the elevated movement trajectory R is necessarily derived.

During the upwards pivoting (or lowering) of the top-tensioning bar 6, the forced-control in the area E' of the connection of the top-tensioning bar 6 and the spreader strut 13 takes effect simultaneously (Fig. 6), so that these two components in common adopt the high position (Fig. 2) bringing about a relaxation of the roof skin 2 in the area of the corner cross-member 7, 7', 7''. The connection E' between the top-tensioning bar 6 and the spreader strut 13 is formed by two guide bars 24 and 24', which are connected by means of a joint F. In this situation the guide bar 24' engages with the spreader strut 13, whereby in particular a torsionally-resistant connection is provided.

In a purposeful embodiment, a drive element 22 in the form of a hydraulic cylinder is provided for the displacement of the top-tensioning bar 6 into the open position, this taking effect independently of the main drive 9. It is likewise conceivable for drive rods (not shown) to be provided for with the main drive element 9, running towards the top-tensioning bar 6, although this requires an additional movement space in the area of the main pivot bearing 10.

The roof skin 2 exhibits in its rear area, between the corner cross-member 7 and the top-tensioning bar 6, the rear window 8, which, during the opening and closing movement of the folding top 1, is guided on the trajectory R defined by the spreader strut 13 and the individual pivot module of the top-tensioning bar in each case (S in Fig. 7; E in Fig. 6) in such a way that the interior of the vehicle with the passenger P is largely uninfluenced by it.

Provided at the top-tensioning bar 6 is an inherently known tensioning unit, which tensions the roof skin 2 in the closed position, with a rear tensioning strut 23 and a front tensioning strut 25, which in turn is connected to the folding-bar module 5. These two tensioning struts 23 and 25 can then be displaced by the drive cylinder 22 out of the dead-point position represented in Fig. 1, when this carries out the opening movement described heretofore in order to move the top-tensioning bar 6. In this situation, a pivot movement takes place about the joint T provided between the tensioning struts 23 and 25.

At the rear tensioning strut 23 the rear window 8 is joint-connected by means of an angle lever 26 in such a way that the rear window 8 is force-guided with the movement of the tensioning strut 23 into the raised position represented in Fig. 2, and a stable support of the rear window 8, aligned essentially vertical, is achieved here by means of the angle piece 26'.

In a purposeful embodiment, the top kinematics arrangement, in the area of the spreader strut 13 and the top-tensioning bar 6 respectively, exhibits a gas pressure spring 27, supported at the main pivot bearing 10, so that the rear-side components of the folding bar 5 are secured in the opening position (Fig. 2) against unwanted downwards movement, the top box element cover (not shown) can be opened unimpeded, and accordingly the displacement of the folding top 2 into the storage position (Fig. 4) in the top box element 14 is possible.

When the folding top 2 opens out of the closed position according to Fig. 1, first the area of the tip 28 of the folding top is released from the windscreen frame, not shown, and then the tensioning bar 6 for the material of the top moves into the almost vertical position (Fig. 2) above the area of the headrests 29, whereby a pivot movement takes place about the point of rotation L. At the same time, by the passing of the dead-point position of the two tensioning struts 23 and 25, the tip 28 of the folding top is raised. The rear window 8 is brought by the top kinematics arrangement described heretofore and represented into a position essentially parallel to the plane of the tensioning bar 6 of the material of the top, and this is located behind the head area of a passenger P in the passenger compartment.

During this movement sequence, the spreader strut 13 is raised by forced movement by means of its parts connecting it to the tensioning bar 6 of the top material, and, as a result, the rear-side top material (not shown) of the top skin 2 is conducted in sympathy by means of the spreader strut in such a way that no additional tension or stresses arise in the top skin 2. The corner cross-members 7, 7' or 7" respectively, joint connected in the area of connecting elements 30, 30' (Fig. 6) in each case, likewise follow the movement described, whereby a relaxation of the roof skin 2 takes place.

Once the opening position according to Fig. 2 has been reached, the cover on the top box element 14 (Fig. 4), not represented in any greater detail, is opened, and the top material tensioning bar 6 is lowered (arrow V in Fig. 3) in the direction towards the top box element 14, whereby the spreader strut 13 is again brought into its cover position at the main column 11. As this depositing movement of the folding top 1 continues, the main column 11 and the spreader strut 13 now pivot in common about the connection point X at the main bearing 10, as far as the deposit position in the top box element 14 (Fig. 4), and the top box element cover can automatically be closed.

When the folding top 1 is guided back into the closed position (Fig. 1), the movement sequence described takes place in the reverse sequence, whereby the spread position of the main column 11 and spreader strut 13 is also provided for in this movement sequence only in the raised position of the tensioning bar 6 for the material of the top.

## Claims

1. Folding top for a convertible vehicle, of which a roof skin (2), exhibiting a rear window (8), a rear top-tensioning bar (6) and at least one corner cross-member (7), is accommodated on the longitudinal edge side between two multi-member folding-bar modules (5) running in a mirror image arrangement to the longitudinal mid-plane (3) of the vehicle, which exhibit in each case, extending towards the rear area of the vehicle, a main column (11) connected to a main drive element (9) and supported on the bodywork side in a main pivot bearing (10), and in the vicinity of which, extending towards the longitudinal mid-plane (3) of the vehicle, in each case an inner guide bar (12) is provided, capable of pivoting in synchrony with the main column (11), characterised in that an outer spreader strut (13) is attached by a joint to the main column (11), and is connected on the longitudinal edge side at least in some areas to the roof skin (2), in such a way that the spreader strut (13), in the closed position of the folding top (1), adopts a cover position on the outside in front of the main column (11).

2. Folding top according to claim 1, characterised in that the spreader strut (13) exhibits a cover position with alignment essentially parallel to the main column (11).

3. Folding top according to claim 1 or 2, characterised in that the spreader strut (13), during the opening movement of the folding-bar module (5), is capable of adjustment at least in phases, independently of the main column (11), in this situation is capable of being pivoted upwards against the direction of travel into a spread position (angle W), and can be retracted from this into the parallel cover position on the outside in front of the main column (11).

4. Folding top according to one of claims 1 to 3, characterised in that the spreader strut (13) and the main column (11) are capable of being pivoted simultaneously.

5. Folding top according to one of claims 1 to 4, characterised in that a joint is provided for between the main column (11) and the spreader strut (13), forming a four-element chain (A, B, C, D) with a front joint lever (15) and a rear joint lever (16).

6. Folding top according to one of claims 1 to 5, characterised in that the spreader strut (13) is force-controlled via a connection to the folding-bar module (5), to the corner cross-member (7), and/or to the top-tensioning bar (6).

7. Folding top according to one of claims 1 to 5, characterised in that the spreader strut (13) is provided with a separate drive element.

8. Folding top according to one of claims 1 to 7, characterised in that the top-tensioning bar (6) interacting with the spreader strut (13) engages in a pivot joint (G; L, L') at a pivot raising module (S; E) supported on the bodywork side, said joint exhibiting a vertical distance (H, H') from the main pivot bearing (10).

9. Folding top according to one of claims 1 to 8, characterised in that the top-tensioning bar (6) interacts in the area of the pivot raising module (S) with a lifting element (18).

10. Folding top according to one of claims 1 to 9, characterised in that the top-tensioning bar (6) is connected in the area of the pivot raising module (S; E) with the spreader strut (13).

11. Folding top according to one of claims 1 to 10, characterised in that the spreader strut (13) is connected at its rear end by means of a jointed chain (E') to the top-tensioning bar (6) relating to the rear area of the roof skin (2), and that an angled support limb (20) is provided at said bar, with at least one vibration strut (21, 21').

12. Folding top according to one of claims 8 to 11, characterised in that the roof skin (2) exhibits, in its area to the rear of the vehicle between the corner mirror (7) and the top-tensioning bar (6), the rear window (8), and that this window, during the opening and closing movement of the folding top (2), is guided on a trajectory (R) defined by the spreader strut (13) and the pivot-raising module (S; E) of the top-tensioning bar (6).

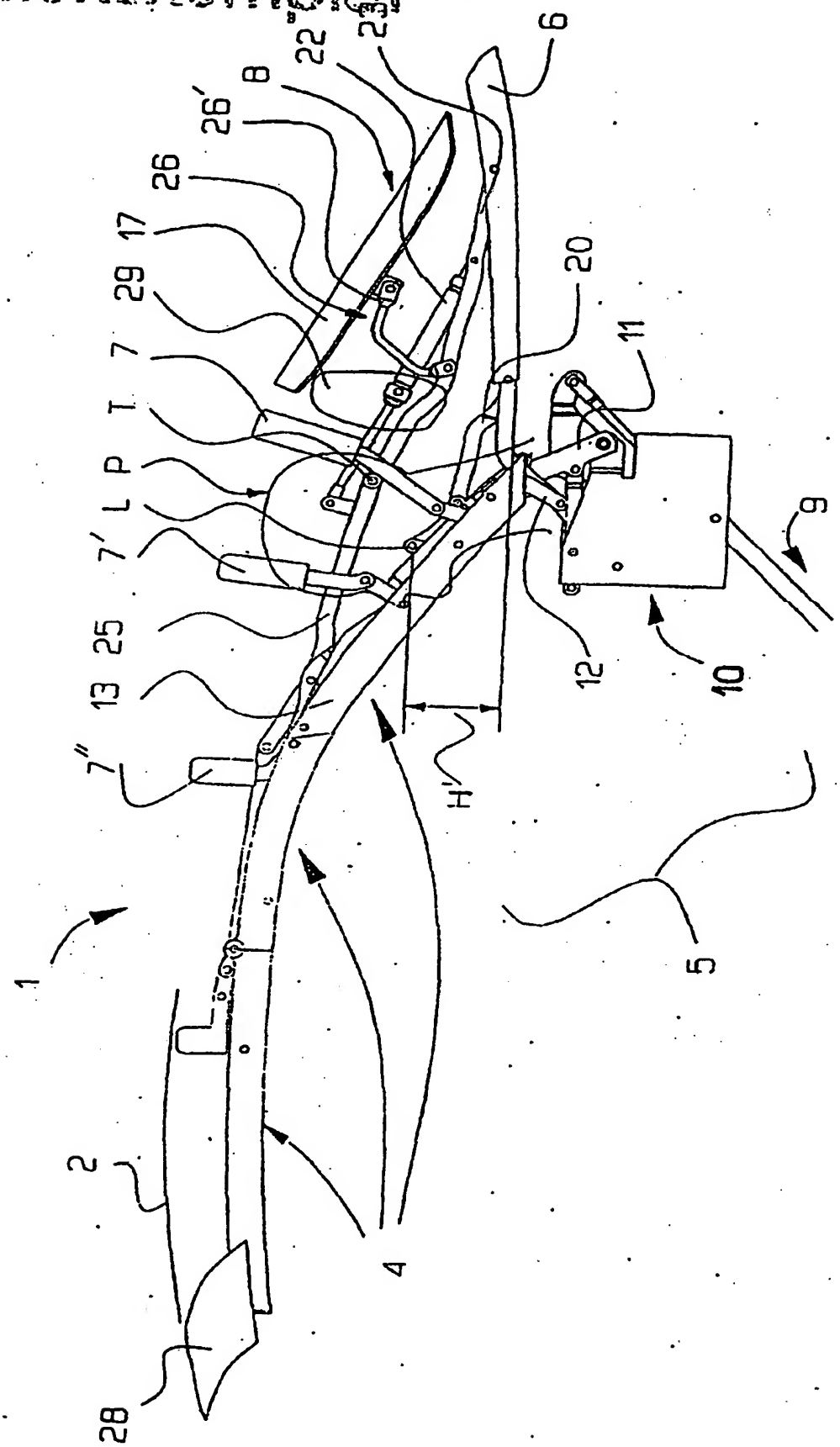
13. Folding top according to one of claims 11 or 12, characterised in that the top-tensioning bar (6) exhibits, at a distance from its support limb (20), at least two tensioning struts (23, 25) running in the longitudinal direction of travel of the vehicle, whereby the tensioning strut (25) which is at the front in the closed position is connected to the folding-bar module (5).

14. Folding top according to claim 13, characterised in that the rear window (8) is joint-connected by means of an angle lever (26) to the rearmost of the two tensioning struts (23).

15. Folding top according to one of claims 13 or 14, characterised in that a hydraulic cylinder as a drive element (22), independent of the main drive element (9), is provided between the two tensioning struts (23, 25).

16. Folding top according to one of claims 1 to 14, characterised in that the spreader strut (13) and/or the top-tensioning bar (6) is/are supported by means of a gas pressure spring (27) on the main pivot bearing (10).

Fig.1



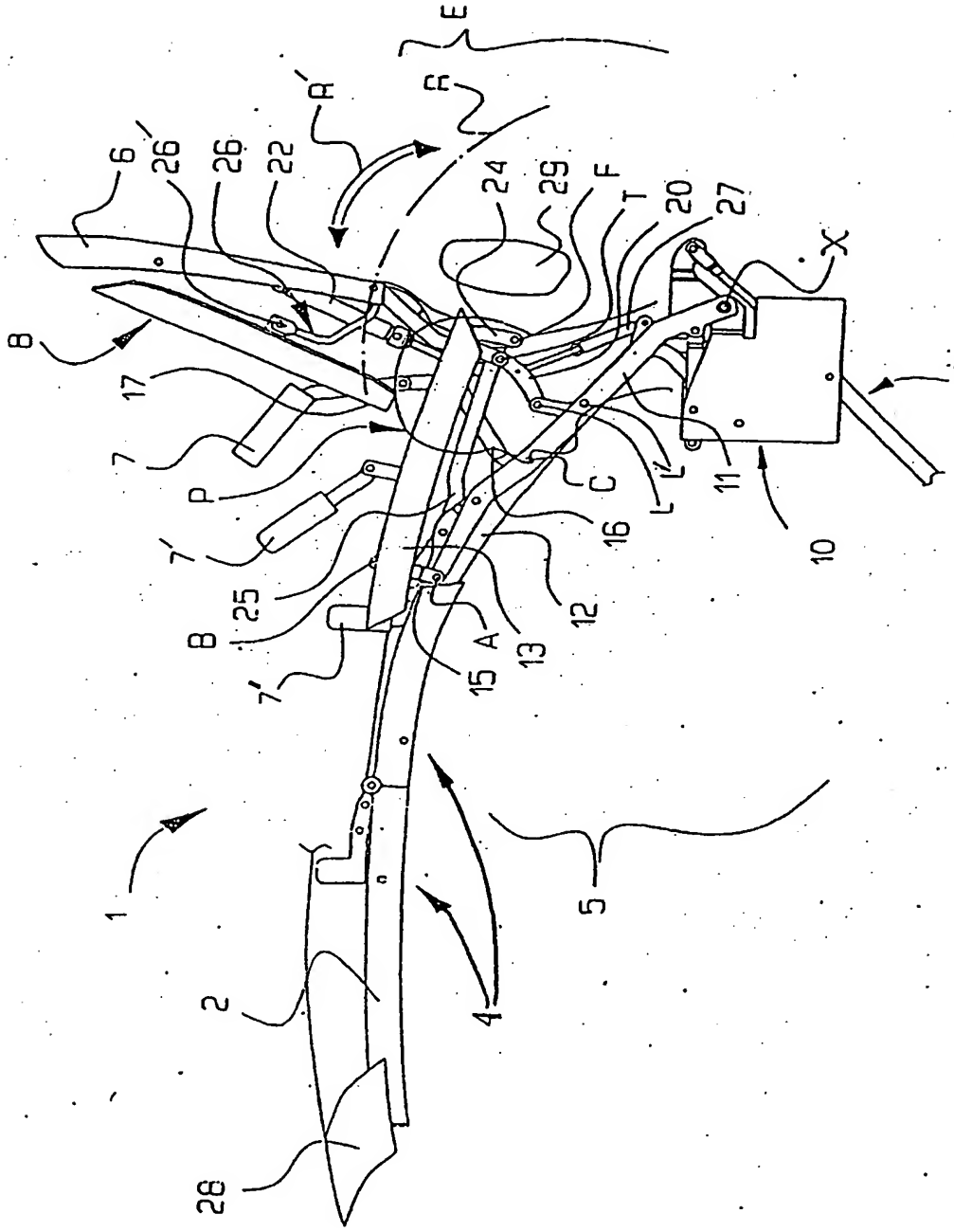

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Fig.2

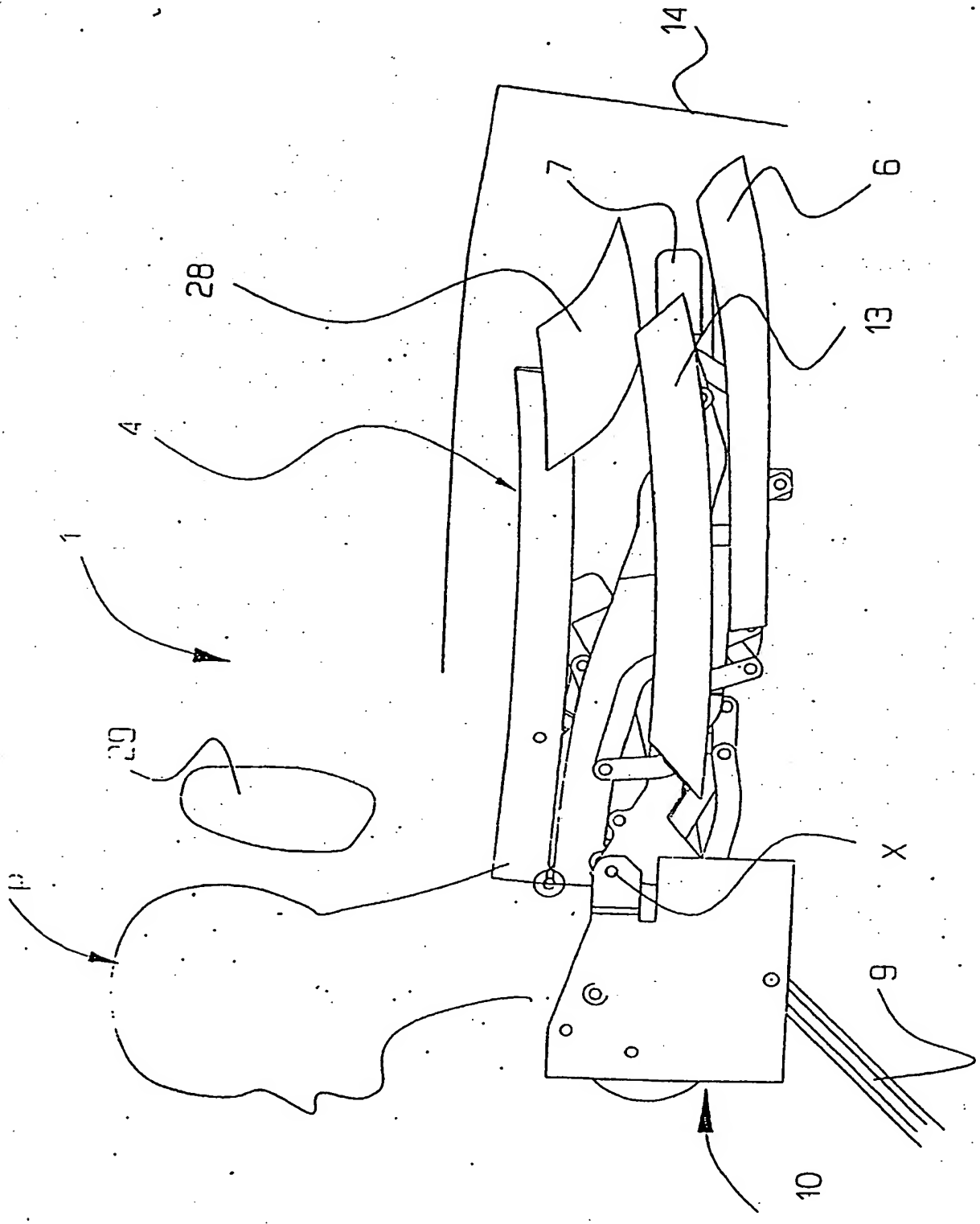


Fig.4

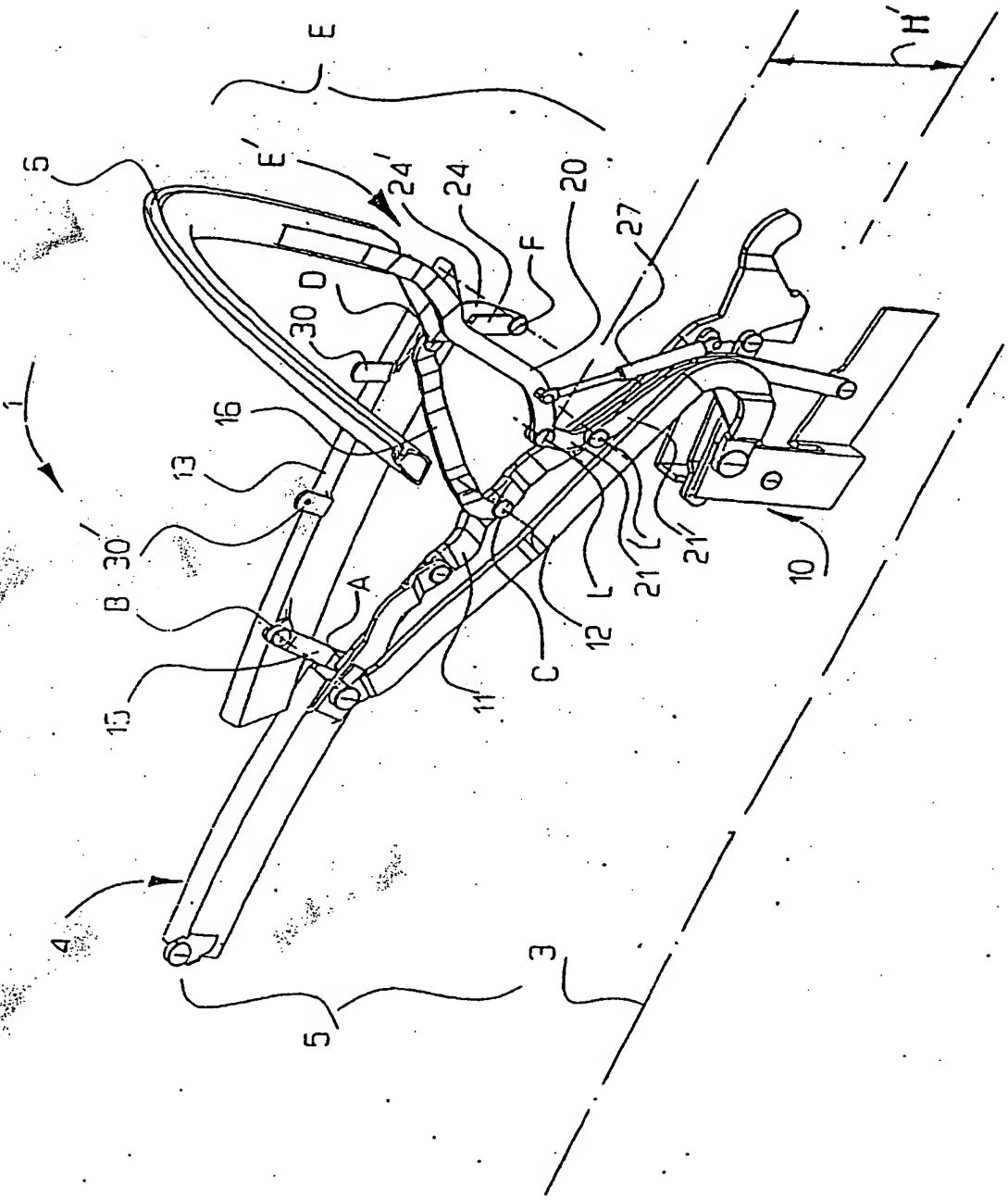


Fig.6